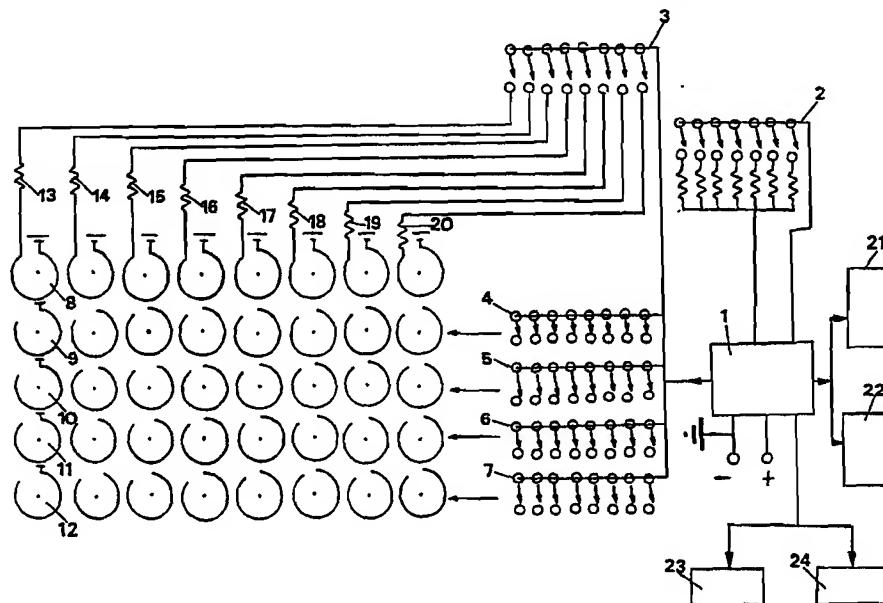


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(54) Title: AN ELECTRONIC DEVICE FOR SMOOTHING OF THE CENTRAL NERVOUS SYSTEM DYSFUNCTIONS IN CONJUNCTION WITH THE USE OF THE BIOMAGNETOMETER SQUID



(57) Abstract

The operation of the present device for smoothing of epileptic seizures and epileptic foci in combination with the SQUID which is based on the disorganization of neuronal generators from which the epileptic foci consist of, is done with the use either of one generator of regulating alternated low voltage which produces a given frequency from 2 Hz to 7 Hz (1) and which supplies a certain number of selected coils of one group which consists of similar rows of coils (8, 9, 10, 11, 12) or more groups (21, 22, 23, 24) of similar coils properly arranged in rows as the first group or of generators of alternating, regulating low voltage which produce each one its own frequency from 2 Hz to 7 Hz and which supply simultaneously a definite number of selected coils of one group (31) or more groups (32, 33, 34, 35) of similar coils properly arranged in rows. The coils of the above cases produce magnetic pulses of square or other forms. With the above described device it is possible to smooth the epileptic foci and also other abnormalities.

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An electronic device for smoothing of the Central nervous system dysfunctions in conjunction with the use of the Biomagnetometer SQUID.

5 The presentation of the invention is referred to an electro-
nic device for smoothing of dysfunctions of the central ner-
vous system with the use of the Biomagnetometer SQUID consi-
sting either of a generator of low alternating voltage and
frequency which can produce a given frequency from 2 to 7Hz
10 and which supplies a defined number of chosen coils of one
group or more groups of similar coils in order
to produce alternating magnetic fields of defi-
ned magnetic field intensity or of generators
of alternating voltage of low frequency which
15 can produce each one its own frequency from 2 to 7Hz and
which can supply simultaneously a defined number of chosen
coils in order to produce alternating magnetic fields. The
pulse of the alternating voltage can be a square or triangu-
lar or sinusoidal or saw-like form. Analogous form can have
20 the alternating magnetic fields which are produced by the
coils the ends of which are connected with the generator ou-
put of the alternating voltage. The number and the cross
section of the coils turns as well as the shape and the
kind of the cores can be varied. The magnetic fields which
25 are produced simultaneously from the coils must be parallel
to the alternating magnetic fields which are emitted from
the brain epileptic foci. In addition the powers and frequen-
cies of the emitted magnetic fields from the coils are of
the same order of magnitude with the ones which are emitted
30 from the epileptic foci. It is apparent the usefulness of
the above device which can smooth the epileptic convulsions
in epileptic patients which although are under anticonvulsi-
ve medication they continue to have seizures. The time re-
quired for smoothing is varied from patient to patient and
35 depends on the size of the epileptic foci. The smoothing
can be repeated by the patient which can have his own device,
which can be calibrated with the use of the Biomagnetometer

SQUID which gives all the epileptic foci or any other brain dysfunctions characteristics. Thus in this way could avoid any side effects because the applied magnetic fields are smaller of the earth's magnetic field. Side effects can give the different anticonvulsive drugs or the different methods of the diagnostic techniques. It is apparent that the first must localize the epileptic foci with the use of the SQUID. Prior to the present invention are the research work and publications by the inventors P.A. Anninos and N.F. Tsagas (Brain research Bulletin, Vol. 16, 1986, International Journal of Neuroscience, Vol. 37, 1987). In the past have invented methods with the use anticonvulsive drugs for smoothing of epileptic seizures for general and focal epilepsy, but without final cancellation of epileptic foci. Final cancellation of epileptic foci can be achieved either with neurosurgery or with the use of leiser, but the disadvantage of these two cores is that they can cause other brain dysfunctions. Most patients in order to avoid surgery prefer the drug treatment which is smoothing temporarily the epileptic seizures.

Other methods also apply instantly strong magnetic fields of the order of 10^5 Gauss which also cause other side effects. The present invention which we describe, has the purpose to improve these disadvantages. The device, according to the present invention has the characteristic to solve the problem of smoothing the epileptic foci or other dysfunctions of central nervous system without the use of the invasive methods. It is absolutely safe because the applied alternating magnetic fields are of small frequency (2 to 7 Hz) and small intensity 10^{-4} to 10^{-8} Gauss which are $1/10^4$ or $1/10^8$ of the earth's magnetic field. The duration for smoothing of the epileptic focus is small of the order of several minutes every time is applied the device to the epileptic foci. The smoothing lasts several days or months and the patient can alone repeat the smoothing when he needs because he feels or senses with certain characteristics signs which tell him that is going to have seizures (smell, taste etc)

The problem is solved with the use of either of one generator of alternating voltage of low frequency which can produce a given frequency from 2 to 7 Hz and which supplies a definite number of selected coils in order to produce alternating magnetic fields of definite intensity or from generators alternating voltage of low frequency which can produce each one its own frequency from 2Hz to 7 Hz and which supply simultaneously a definite number of selected coils for the production of alternating magnetic fields of definite intensity. The form of the alternating magnetic fields which are produced from the coils the ends of which are connected with the output of the generator of the alternating voltage is square wave (symmetrical or nonsymmetrical) or triangular or sinusoidal or saw-like form. The number of turns and the cross section of the coils as well as the shape and the material of the cores can vary (plastic, ferite and other material of certain magnetic permeability). The produced alternating magnetic fields must be parallel to the alternating magnetic fields which are emitted from the neuronal generators of the epileptic foci. That is the surface of the coils must be applied simultaneously and parallel to the projected epileptic foci on the skull or in another abnormal part of the central nervous system. The power and the frequency of the magnetic field of the coils are of the same order of the magnitude with the magnetic fields which are emitted from the epileptic foci. The precise position of the epileptic foci the intensity and the frequency of the magnetic fields which are emitted from this epileptic foci and which are specific for each patient are defined precisely with the use of the biomagnetometer SQUID. The use of SQUID is described in details in the above mentioned publications. The smoothing effects of the present electronic invention in all patients were encouraging.

The advantages of this invention are mainly the fast, painless and noninvasive smoothing of the epileptic foci and the effective reduce of the epileptic seizures. The same patient can perform its own smoothing with the use of the electronic invention of the present

invention. From the above it is seen that the present electronic invention combines a serious number of advantages.

A way of application of the present invention is described below by referring to the figures which accompany it and explain with clarity and technical details for understand in order to avoid any misunderstanding.

The figure 1 of the present invention gives the general
10 principale of operation of the device according to the representation of the invention which consists of a generator of alternating low voltage and frequency (1) which can produce a definite frequency from 2 Hz to 7 Hz, of a switch (2) of selecting the frequencies from 2 Hz to 7 Hz, of switches
15 (3,4,5,6,7) of selecting the coils for their supply from the selecting frequency and of one or more groups of coils placed in proper order in similar rows.

The figure 2 of the present invention gives the general
20 principal of operation of the device according with the description of the invention which consists of generators of alternating low voltages and frequencies which produce each one its own frequency from 2 Hz to 7 Hz, of a key board of selecting generators and coils, of a code maker decode maker
25 of the key board, of a system of memory reading, of a screen display, of a combined circuit and of one group of several groups or several groups of similar coils properly arranged in rows.

The figure 3a of the present invention is the isospectral
30 map which is produced from the measurments by the SQUID of the left temporal region of an epileptic patient before the smoothing.

The figure 3b of the present invention is the corresponding map which is produced from measurements os the same region
35 of the brain og the same patient with the use of the SQUID after applying the smoothing which is performed with the use of the present electronic device of the present inven-

tion. The figures 1 and 2 give the general principle of operation of the electronic device which can produce alternating magnetic fields for smoothing dysfunction of the central nervous system, consisting basically of a generator of alternating low voltage which can produce frequencies 2 to 7Hz (1) of a switch of selecting frequencies (2) of switches of selecting coils (3, 4, 5, 6, 7) of one group of similar coils properly arranged in rows (8, 9, 10, 11, 12) or more similar groups (21, 22, 23, 24), of resistances (13, 14, 15, 16, 17, 18, 19, 20) which connect the coils of the first row (8) with the switch of selecting coils (3) and similar resistances which connect all the other coils of the rows (9, 10, 11, 12) with the switches (4, 5, 6, 7) and similarly for the other groups of coils. The figures also show another type of electronic device consisting of seven generators of low alternated voltage and frequency which can produce each one its own frequency from 2 Hz to 7 Hz (25), of key board of selecting generators and coils (26), of a code maker/decode maker (27), of a reading memory system (28), of a display screen (30), of a combined circuit (29) and of one group of similar coils properly, arranged in rows (31) or more similar groups (32, 33, 34, 35). The coils of small diameter about one cm are enclosed between two parallel plane surfaces in such a way so that the axis of the coils to be perpendicular to these surfaces which are located parallel to the projection of the epileptic foci on the skull. The foci (36, 37, 38, 39) with the corresponding power amplitudes above 2200 FT/√Hz, below of 2200 FT/√Hz, above of 1800 FT/√Hz and below of 1400 FT/√Hz resulted from the isospectral mapping of the left temporal region of one patient with the use of the SQUID before smoothing. The determination of the coordinates of the epileptic foci (36, 37, 38, 39) is done with the use of the SQUID. The powers of the isospectral lines resulted also from the mapping with the use of the SQUID. The epileptic foci (36, 37, 38, 39) have been disappeared as it is seen in the corresponding region (40) after the application of the present electronic device of the present invention where the corresponding isospectral amplitudes are below 800 FT/√Hz.

C L A I M S

1. The present electronic device for smoothing of the central Nervous System dysfunctions in conjunction with the Biomagnetometer SQUID, consists either of a generator with regulating low alternating voltage which produces a given frequency from 2 Hz up to 7 Hz(1) and which supplies a defined number of chosen coils of one group which consists of the coils in the rows (8,9,10,11,12) or more groups (21,22,23,24) of similar coils in proper arrangement in rows which produce square pulses (symetrical or asymetrical) or triangular or sinusoidal or saw-like or other form or other combinations of the above forms or of generators with regulating low alternating voltage which produce each one its own frequency from 2Hz up to 7Hz and which they supply simultaneously a definite number of chosen coils of one group (31) or more groups (32,33,34,35) of similar coils in proper arrangement in rows which produce square pulses or triangular or sinusoidal or saw-like or other form which pass through the coils which can have cores of different sizes, forms and magnetic permeability in order to produce alternating magnetic fields parallel to the varying magnetic fields emitted from the epileptic foci which are determined with all characteristics of frequencies, powers, magnitudes and coordinates provided with the help of biomagnetometer SQUID for the desynchronization or detuning of the neuronal generators which emit synchronized magnetic energy from the epileptic foci.

2. The present electronic device for smoothing of the central nervous system dysfunctions in conjunction with the Biomagnetometer SQUID, according to the claim 1, is characterized by the fact that consists of a generator with a regulating low alternating voltage and frequency (1), of a switch of selecting the frequencies (2), of the switches of selecting coils (3,4,5,6,7), of one group of coils which consists of the coil rows (8,9,10,11,12) or of two or three or four or more groups of coils (21,22,23,24) which all have

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the same number of rows and of resistances (13,14,15,16, 17,18,19,20) which connect the coils of the first row (8) with the switch which selects the coils (3) and similar resistances connect all the other coils of the rows (9,10,11, 5 12) with the switches (4,5,6,7) and similarly for the other groups of coils. The generator (1) produces a certain frequency from 2Hz to 7Hz and feeds a definite number of selecting coils in order to produce magnetic pulses of square or sinusoidal or triangular or saw-like or a combination of the above 10 forms. The coils can be selected in such a way so that to have or not to have cores of the same type which can be of different materials. The coils are enclosed between two parallel plane surfaces so that their axis to be perpendicular to these surfaces which are located parallel to the projected epileptic foci on skull during the smoothing. The perpendicular cross section of the coils is mostly circular form 15 and the number of turns of the coils is relatively small and consists of isolated wire of small external cross section and usually good conductance (silver, copper etc.)

20

3. The present electronic device for smoothing of the central Nervous System dysfunctions in conjunction with the Bio-magnetometer SQUID according with the claims 1 and 2 is characterized by the fact that it can be consisted of generators of alternating voltage of low frequency which can 25 produce each one its own frequency in the range from 2Hz-7Hz(25), of a keyboard of selecting the generators and coils (26) of a code maker/decode maker of the keyboard (27), of a system of memory reading (28) of a screen 30 (30), of a combined circuit (29) and of a group of similar coils in proper arrangement in rows (31) or two or three or four or more similar groups of coils (32,33,34,35) where can be included the first group (31) namely a sum of five groups. The coils are enclosed between two parallel plane 35 surfaces in such a way so that the axis of the coils to be perpendicular to the surfaces which are located parallel to the projected epileptic foci on the skull during the

smoothing. The generators feed with alternating voltage the coils which can produce square magnetic pulses or triangular or saw-like or sinusoidal or a combination of the above forms. The coils of the different groups (31,32,33,34,35) are connected with the combinatory circuit (29) through resistors. The cross-section of the coils is mostly circular form and the number of turns of the coils is relatively small and consists of an isolated wire of small external cross section and usually good conductance.

10

4. The present electronic device for smoothing of the central nervous system dysfunctions in conjunction with the biomagnetometer SQUID according to the claims 1, 2 and 3 is characterized by the fact that the effectiveness of the function of the invention is based in the proper use of the Biomagnetometer SQUID, at least for the first smoothing of the patient during which the first calibration of the device is performed. With the use of the SQUID the probe of which does not come in contact with skull we are measuring for each patient and for each hemisphere of the brain 32 points the distance of which is 1.5 cm which is half of the SQUID sensor diameter in order to avoid between near points magnetic overlapping. These points which form a matrix of rectangular shape are located around the reference points of the 10-20 international point system for electrode placement. These reference points are T3,T4,P3,P4,F3,F4 for left or right temporal hemisphere, left or right occipital hemisphere and left or right frontal brain region. These 32 points are located with a self-adhesive paper on a plastic hat which is located on the patients head prior to the location of the reference points.

These 32 points which as we stated above they are 1.5 cm from one another, are located in perfectly defined positions in the skull with the help of the self-adhesive paper provided that the coordinates of the reference points have been defined because by knowing the coordinates of these points we know also the coordinates of all 32 points and consequently we

35

know the coordinates of the epileptic foci (36,37,38). After is located the probe sensor of the SQUID 3 mm above each measuring point and we are taking 32 consecutive measurements of one second duration each from each point with
 5 sampling frequency of 256 Hz. The measurement of each point is analyzed using Fourier statistical analysis and is examined the amplitude distribution of the fourier power spectrum in a given frequency or in a given range of frequencies. With the help of electronic computers we connect all equal
 10 power spectra amplitudes for a given frequency or a given frequency range and in this way we obtain maps of iso-spectra amplitudes (figures 3a, 3b). From these maps and from the power spectrum density we can get results if there are epileptic foci (36,37,38) and also the coordinates and the power
 15 of these epileptic foci. Finally from this analysis after the identification of the epileptic foci (36,37,38) with the help of spectra analysis, we can find the frequency of the emitted field from the focus. In this way it is seen that the device is completely connected with the SQUID measurements due to the fact that it is necessary for the calibration
 20 of the device of the present invention. In other words the patient is not able alone to locate the device on his skull without the above informations because it can disorganize other regions of his brain which do not need such
 25 disorganization if his brain must work properly. The epileptic foci (36,37,38,39) with corresponding magnitudes which varied from $1200 \text{ fT}/\sqrt{\text{Hz}}$ and above of $2200 \text{ fT}/\sqrt{\text{Hz}}$ with the application of the modified electronic device of the present invention they reduced all to the physiological
 30 emitted levels which are below of $800 \text{ fT}/\sqrt{\text{Hz}}$ (Fig.3b)

5. The present electronic device for smoothing of the central nervous system dysfunctions in conjunction with Biomagnetometer SQUID according to the claims 1,2,3,4 is characterized
 35 by the fact that it can also with the use of the SQUID and alternating magnetic and electric fields of different power and frequencies to be applied for the smoothing of inadequate

kidney function, migraines, brain infarct, rheumatic pains, sciatic pains and different gynecological and obstetrical problems during prenatal and postnatal periods, multiple sclerosis, parkinson, leucemia, meningitis, melancholies, schizophrenia, liver abnormalities, spleen abnormalities, bone diseases, thyroid abnormalities, pain abnormalities from the trigeminal nerve and for the location and smoothing of brain dysfunctions in fetuses during the prenatal period and also the localization and smoothing of the abnormalities in the spinal cord.

10

6. The present electronic device for smoothing of the central nervous system dysfunctions according to the claims 1, 2, 3, 4, 5 is characterized by the fact that the smoothing and the cancellation of the epileptic foci remains for several days or months and is due to the influence of the external alternating magnetic field which is inducing inhibitory potentials in the synapsis of the neurons in the region of the brain in which the electronic device is applied.

20 7. The present electronic device for the smoothing of central nervous system dysfunctions according with the claims 1, 2, 3, 4, 5, 6, is characterized by the fact that the time for smoothing is depending on the depth of the epileptic foci. For deeper epileptic foci is required more time for smoothing.

25

8. The present electronic device for the smoothing of central nervous system dysfunctions according to the claims 1, 2, 3, 4, 5, 6, 7 is characterized by the fact that we don't have any effect when it is applied to patient which they have in their brain
30 cysts, tumors, infarcts, valves or if they have experienced neurosurgery.

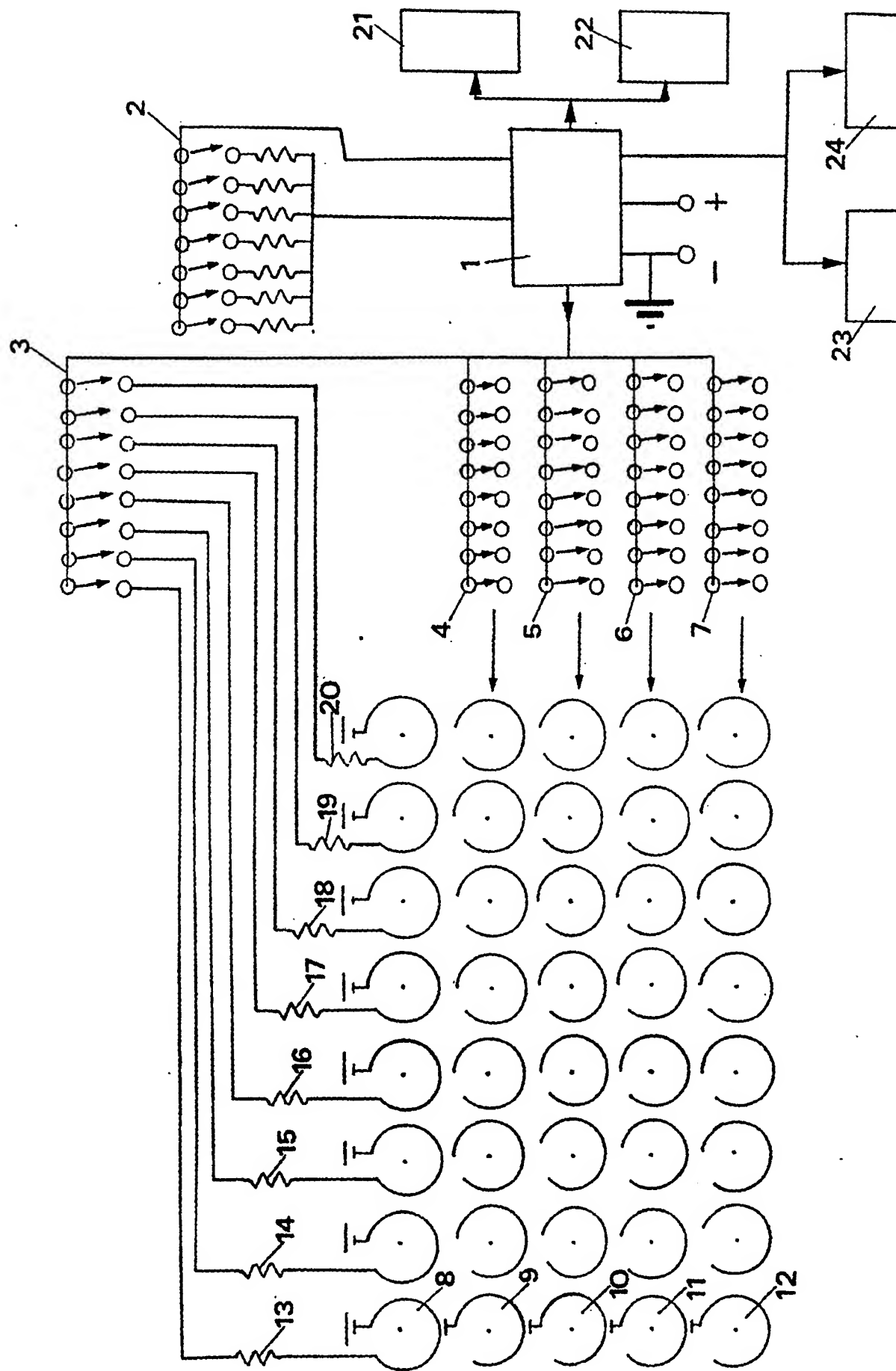


Fig. 1

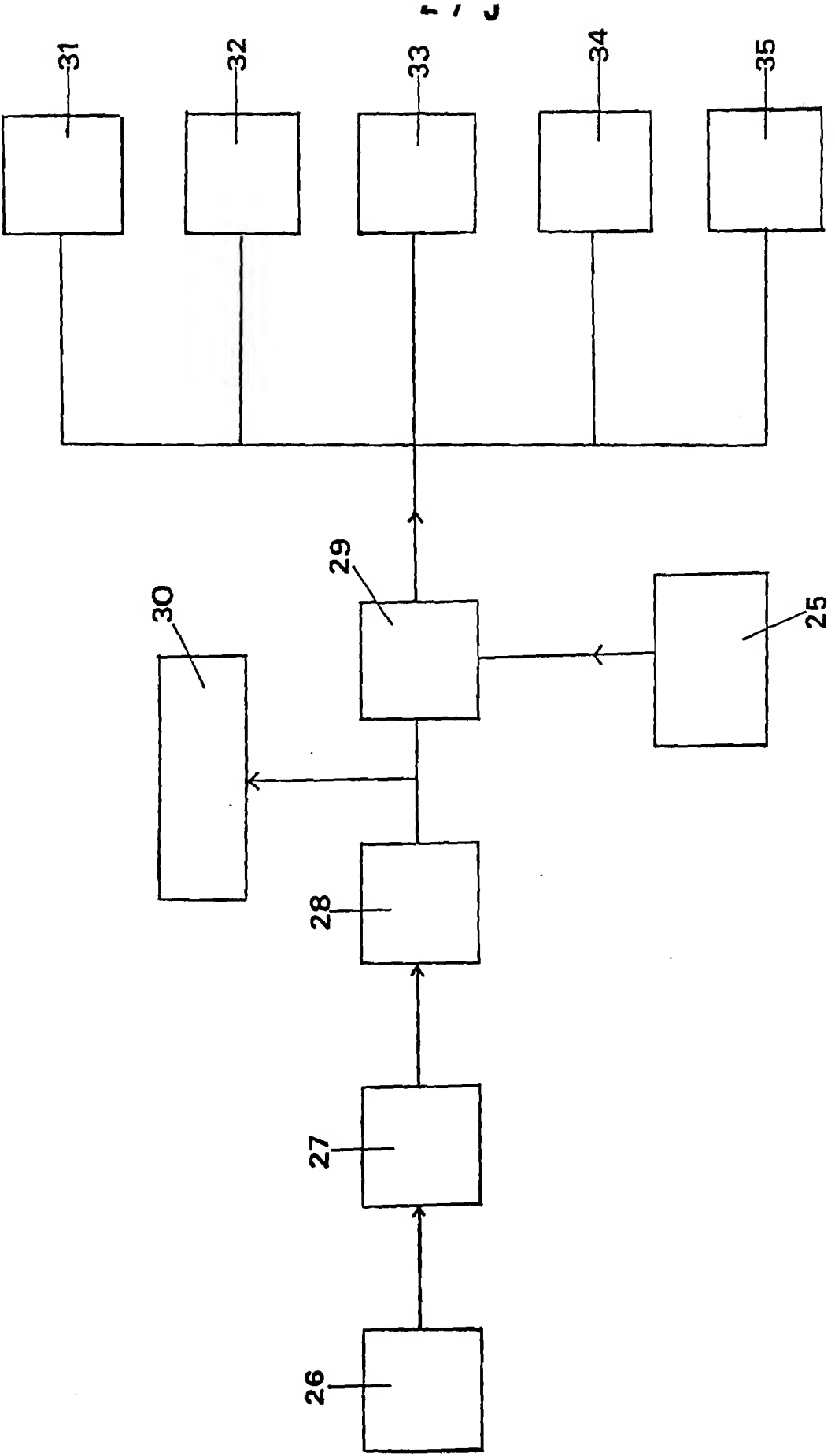


Fig -2

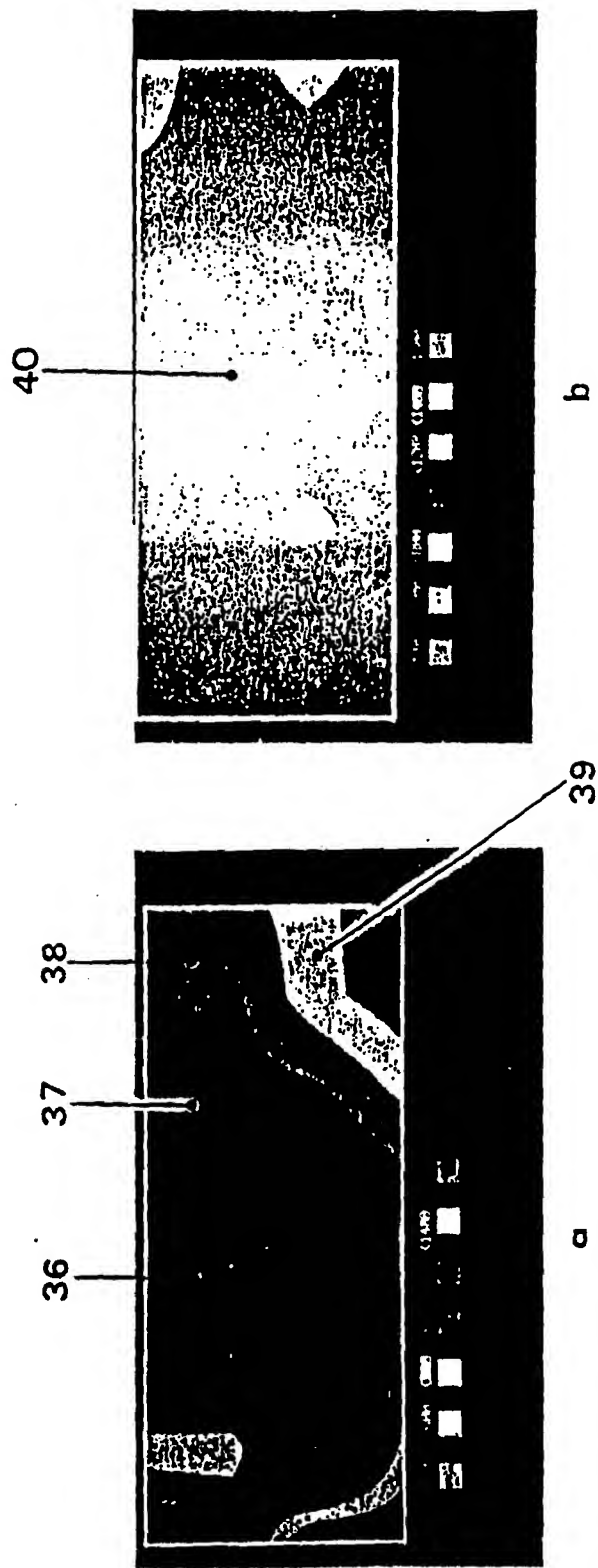



Fig - 3

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 A61N2/04		
II. FIELDS SEARCHED		
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Classification System	Classification Symbols	
Int.Cl. 5	A61N	
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III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	PHYSICS TODAY. vol. 39, no. 3, March 1986, NEW YORK US pages 36 - 44; John CLARKE: "SQUIDS, brains and gravity waves" see pages 41 - 42 ---	1-8
A	EP,A,84019 (LKH AG) 20 July 1983 see page 1, paragraph 1 - page 4, paragraph 2 ---	1, 2, 5, 6
A	EP,A,99734 (TESLA,KONCERNOVY PODNIK) 01 February 1984 see the whole document ---	1-3
A	DE,A,2707574 (GÖDDE) 24 August 1978 see pages 22 - 25 ---	1, 3
A	FR,A,2370483 (CONSTANTINESCU) 09 June 1978 see the whole document ---	1, 5
¹⁰ Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
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International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	LEMERCIER D. L. L. 	

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.

GR 9000002
SA 40750

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
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21/01/91

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-84019	20-07-83	None	
EP-A-99734	01-02-84	US-A- 4693238	15-09-87
DE-A-2707574	24-08-78	None	
FR-A-2370483	09-06-78	None	